Review 18 position, velocity, acceleration

motion along a line (1 dimensional)

position $x(t)$

velocity $v(t) = x'(t) = \frac{dx}{dt}$

acceleration $a(t) = v'(t) = x''(t) = \frac{d^2x}{dt^2}$

speed $= |v|$

Describe the motion: left $v<0$, right $v>0$, at rest $v=0$

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Find position from velocity

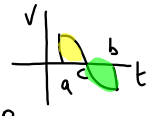
final pos. $= \int_a^b v(t)\,dt$ + initial pos.

displacement

displacement = position relative to initial pos.

position: relative to origin

distance (total area) $\int_a^b |v|\,dt$



break it up

$\int_a^c v\,dt + \left|\int_c^b v\,dt\right|$

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Motion in a plane (2 dimensional)

parametric, vector

position $\hat{r}(t) = \langle x(t), y(t) \rangle$

velocity $\hat{v}(t) = \langle x'(t), y'(t) \rangle$

acceleration $\hat{a}(t) = \langle x''(t), y''(t) \rangle$

speed $= |\hat{v}| = \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}$

$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$

Slope of $\hat{v}$

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given $\hat{v}$, find $\hat{r}$ (position)

$\hat{r} = \left\langle \int_a^b x'(t)\,dt + x_a, \int_a^b y'(t)\,dt + y_a \right\rangle$

total distance $= \int_a^b \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\,dt$

curve length

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Ex. Particle moves in a plane

$\frac{dx}{dt} = \sqrt{3t}$ $\frac{dy}{dt} = 3\cos\left(\frac{t^2}{2}\right)$

at $t = 4$, position $(1, 5)$

a) find $\hat{a}(4)$ $\left\langle \frac{\sqrt{3}}{4}, -11.872 \right\rangle$

b) find $y(0)$ 1.6006 $\int_4^0 3\cos\left(\frac{t^2}{2}\right) dt + 5$

c) when is speed first equal to 3.5 on $[0, 4]$ $t = 2.2256$

d) total distance on $0 \le t \le 4$ 13.1824

c) $\sqrt{\left(\sqrt{3t}\right)^2 + \left(3\cos\left(\frac{t^2}{2}\right)\right)^2} = 3.5$ $\Big|_{0 \le t \le 4}$ =

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